

5

Minutes

WITH

MONEL

METAL

MONEL METAL is a solid, silvery-white alloy containing approximately two-thirds nickel and one-third copper. It possesses remarkable corrosion resistance to practically all alkalies, to most acids and salts, as well as to organic substances. It cannot rust. Monel Metal is unique because of the fact that, combined with this resistance to corrosion, it possesses high mechanical strengths, superior to those of mild steel. Monel Metal is readily worked by all conventional methods of fabrication.



5 MINUTES WITH MONEL METAL

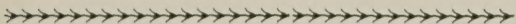
*A brief summary of experiences
of over a quarter of a century*

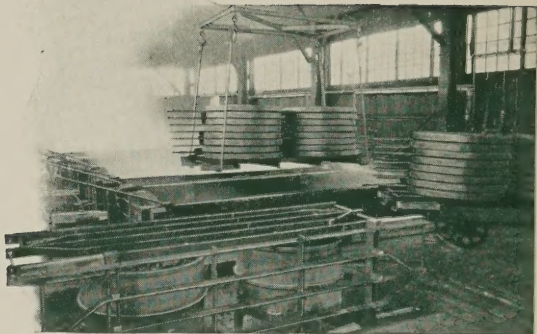
THERE is no application in which only one property of a metal is used and suitability must be determined by balancing the requirements of the service against the properties available in the proposed material.

While a tabulation of the individual properties of a metal will serve in judging its value for various purposes, the best guide usually will be found in its performance under conditions which have put the combined properties to a practical test.

Here then is a brief summary of the successful application of Monel Metal under widely diversified conditions in many industrial fields—a service record covering over a quarter of a century of use arranged in a quickly read fashion for the convenience of the busy metal user.

Obviously, this information is general in nature. More detailed data may be obtained from The International Nickel Company, whose technical staff is always available for consultation and advice on the use of Monel Metal.





Because of its remarkable resistance to corrosion, Monel Metal equipment is widely used for the cleaning of other metals in hot acid pickling baths.

RESISTS CORROSION

High corrosion resistance is the most noted quality of Monel Metal. It cannot rust. In addition to withstanding such common corrosives as lye, salt and sulphuric acid, Monel Metal resists a wider range of corrosive conditions, probably, than any other one metal or alloy.

In the textile industry, for example, Monel Metal is the standard material for many types of equipment—chiefly because it resists hot and cold solutions of acids and caustics.

The chemical and process industries use Monel Metal equipment even more extensively—in manufacturing high-grade soaps, perfumes, extracts, essential oils, dyestuffs, varnishes and lacquers; in refining salt, lubricating oils; in treating leather; in reclaiming materials from waste liquors, and so on.



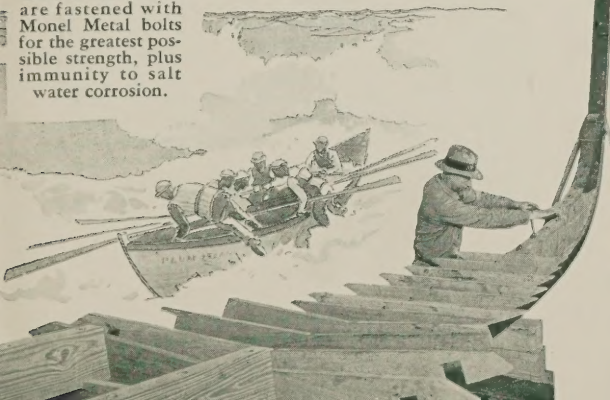
STRONG

The outstanding advantage of Monel Metal is its unusual combination of corrosion resistance with great strength. It is 30% stronger than the steel used in bridge construction.

These properties are essential for metal pickling equipment handling heavy loads in steel mills, for pump and high speed propeller shafting, and for bolts and other fastenings that must be strong, and remain strong, in spite of corrosive conditions.

Monel Metal retains its strength to a high degree at elevated temperatures. This characteristic is responsible for its employment as turbine blading which must withstand severe centrifugal stresses at the extreme operating speeds encountered under conditions of high temperature and high pressure.

All structural members of U. S. Coast Guard surf boats are fastened with Monel Metal bolts for the greatest possible strength, plus immunity to salt water corrosion.



ATTRACTIVE IN APPEARANCE

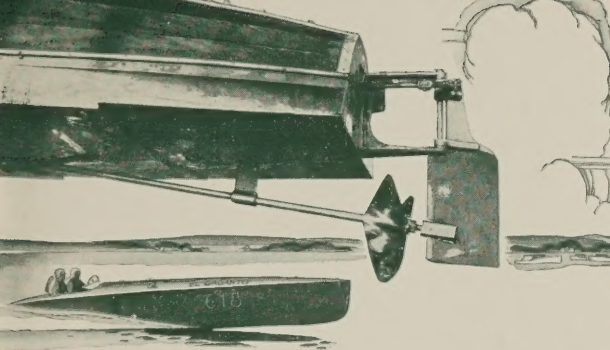
The silvery-white color of Monel Metal is pleasing in each of a variety of finishes ranging from a soft, satin glow to a brilliant mirror-like polish. It is a durable and permanent metal—solid all the way through with no coating to chip or wear off.

The ease with which this pleasing appearance is maintained has made it particularly popular for commercial, institutional and domestic kitchen equipment.

It is also used for hot water heating and storage tanks for the home, a logical and an increasingly important application which makes full utilization of Monel Metal's properties of strength and immunity to rust.



Attractive, easy to maintain, and durable, Monel Metal is popular for sinks and working surfaces in modern kitchens.



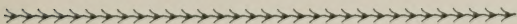
The propeller shaft on the famous Gold Cup racing boat "El Lagarto" is Monel Metal because it has to be tough and stiff to withstand the terrific wrench of the rudder when she whips around the turns at better than 60 miles an hour.

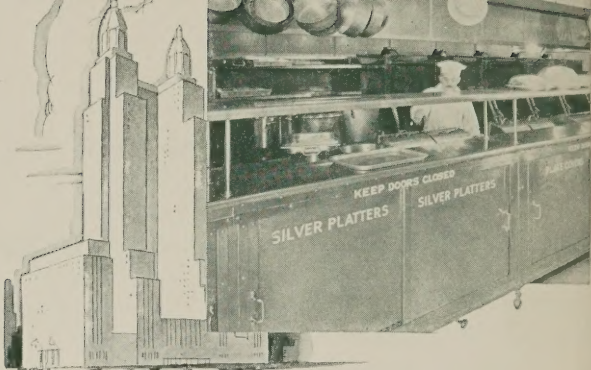
TOUGH AND RIGID

Standard impact tests for measuring the resistance of metals to breakage under hammer blows show that Monel Metal is one of the toughest of metals. It can stand a blow 50% greater than what is required to break the tough alloy steels used for railway axles. Sub-zero temperatures have no effect on its toughness.

Applications that require a tough metal usually demand one which also has high rigidity or resistance to bending. Monel Metal is approximately twice as stiff as bronze.

These are the principal reasons why Monel Metal is used for such applications as motor boat propellers, shafting of all sorts, bolts and other machine parts that must stand impacts and hard service without bending or breaking.





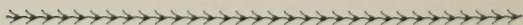
New York's Waldorf-Astoria, and most of the other leading hotels of the country, use Monel Metal food service equipment throughout.

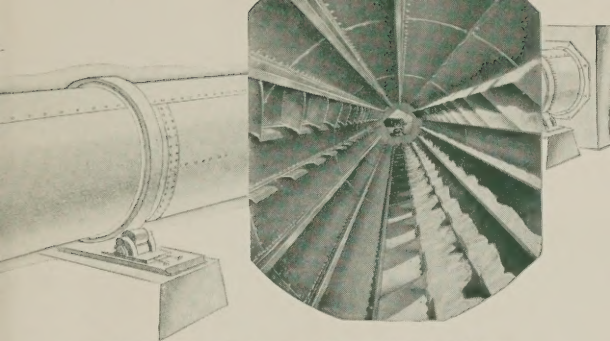
EASY TO MAINTAIN

In large scale food service equipment, maintenance is more than an inconvenience—it is an overhead cost which must be kept down at a minimum. For this reason, Monel Metal is used for food service equipment in hotels, restaurants, ocean liners and institutions—not only because it is easily kept bright and clean; it withstands hard usage, never rusts or wears out.

For such equipment, Monel Metal is the standard material. It is used in the finest kitchens, for example, New York's Waldorf-Astoria, Radio City's Rainbow Room, and Cunard-White Star's "Queen Mary."

The sparkling Monel Metal ice cream cabinet tops one sees wherever he goes also show how this metal retains its silvery lustre under constant service.





In the drying of salt, the revolving cylindrical driers are lined with Monel Metal to withstand the highly abrasive and corrosive action of the damp salt.

RESISTS ABRASION

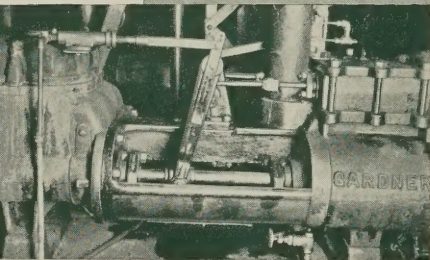
Monel Metal is noted for its hard, dense structure which gives it the ability to withstand abrasion and hard usage.

The wear-resisting properties of Monel Metal are applied in equipment such as pumps and valves handling gravel-laden water; for screens on condenser intake lines in polluted waters; for sleeves to protect propeller shafts from severe wear in the bearings on boats dredging sand and gravel; and similar uses.

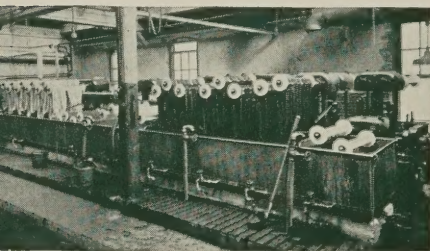
This resistance to wear, coupled with its ability to withstand corrosion, makes Monel Metal wire cloth especially suited for the screening of abrasive and corrosive materials, for removing solids from liquids, and for general filtration purposes. Applications of this nature include the filtering of sugar, the removal of Fuller's earth from lubricating oils, the removal of spent lime from caustic soda and the like.



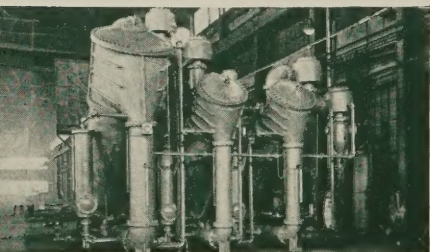
MONEL METAL



Long-wearing, non-rusting Monel Metal pump rods find many industrial uses.



Colors are quickly changed in Monel Metal dye equipment.



Monel Metal equipped evaporator for handling by-product in food industry.

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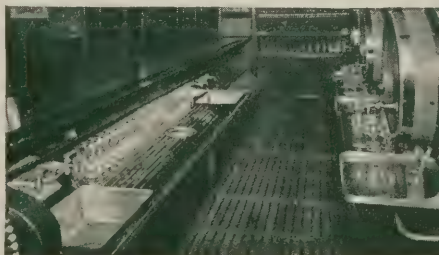
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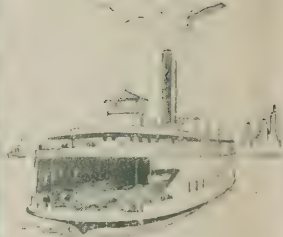
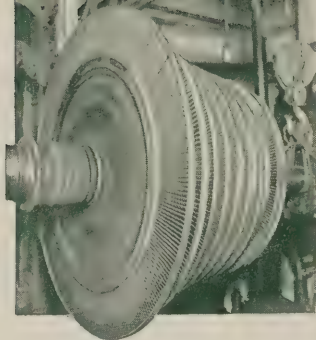
Monel Metal kettles make better varnish
and have a longer life.



Monel Metal laundry equipment protects
as well as cleans delicate fabrics.



Monel Metal working surfaces keep the
modern bar spic and span.



Monel Metal turbine blades on the ferryboat "Whitehall" have withstood the action of superheated steam for seven years without signs of wear or other deterioration.

WITHSTANDS SUPERHEATED STEAM

Because of the strength of Monel Metal at high temperatures and because it withstands corrosion and the erosive action of superheated steam it is used extensively in power plant equipment where long life is required.

Monel Metal valve seats, stems and discs, expansion joints, governor parts, pump rods and liners, shafts, springs, turbine blading and other parts of power plant equipment are in use against superheated steam.

The coefficient of expansion of Monel Metal is sufficiently close to that of steel to permit its use in conjunction with steel for parts controlling the flow of superheated steam and directly exposed to its erosive action.





Pharmaceuticals are processed in Monel Metal equipment to keep them pure and free from contamination. These Monel Metal melting and mixing units are used by Ex-Lax Company.

PROTECTS THE PRODUCT

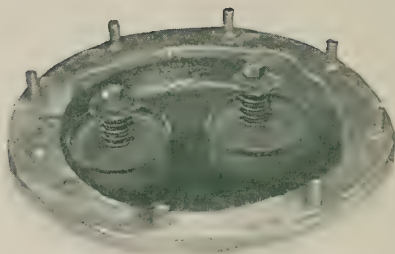
Monel Metal is especially adapted for equipment in processing plants of many kinds. Its extremely low solubility prevents contamination and discoloration. Its smooth, hard surface resists corrosion and is easy to keep clean. Furthermore, being a solid metal all the way through there is no surface coating to chip, crack, or come off.

Meat packers use Monel Metal in many ways because it is absolutely sanitary and unaffected by fats, salt meats and juices.

The food canning industry makes extensive use of Monel Metal to protect the purity and the taste of soups, vegetables and fruits.

Much better control of color is obtained in Monel Metal dyeing machines because the metal is non-absorbent and can be thoroughly and easily cleaned between changes of color.





The resiliency of Monel Metal is called upon in its use for pump valve springs under constant operation.

RESILIENT

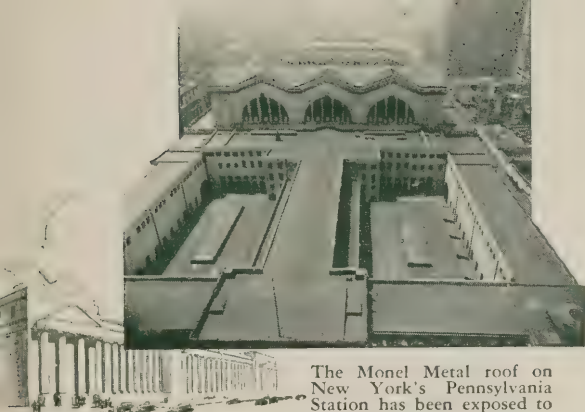
In spring use and where shock and vibration are encountered, Monel Metal shows a very high resistance to fatigue or alternating stress.

Monel Metal springs are in use in dyeing machines where they come in contact with corrosive dye liquors, in steam traps where high temperatures prevail, for clips in photographic solutions and for pump valves handling various corrosive and abrasive liquids.

In its use for the thermostatic control of electrical household equipment, the Monel Metal spring element is called upon to operate at all temperatures accurately.

Monel Metal bolts are used on railroad signal and high tension electric equipment because they withstand the destructive effect of vibration found in this service.





The Monel Metal roof on New York's Pennsylvania Station has been exposed to the weather for 26 years without showing measurable corrosion. Recently, 10 more tons of Monel Metal were used to make new skylight frames replacing another metal.

EXPERIENCE

Every recommendation for using Monel Metal is based on a wealth of information and data which show how it has behaved in actual service, under almost every conceivable condition, since it was first used in 1905.

From these service records, one can reasonably estimate the suitability of Monel Metal for a new application or determine how well it should perform in applications where it has previously been used time and again.

This information is readily available to you and The International Nickel Company will give you their full cooperation in selecting a material suitable for your purpose.





Monel Metal is Available in All Forms

Our complete rolling mill at Huntington, W. Va., is devoted to the production of Monel Metal in the following basic forms:

Angles—Hot Rolled
and Cold Rolled

Castings

Forgings

Pipe—I.P.S. and Ex-
tra heavy I.P.S.

Plate—Hot Rolled

Rods and Flats and

Special Shapes —

Hot Rolled and

Cold Drawn

Sheet—Cold Rolled and
Full Finished

Strip—Cold Rolled

Tubing — Cold Drawn
and Hot Rolled Seam-
less

Welding Wire—

Plain and Flux-coated

Wire — Annealed and
Spring Temper

Monel Metal is Readily Workable

Though the preceding forms indicate the workability of Monel Metal, special studies of working methods have been embodied in the following shop instruction sheets which will be sent upon request:

Machining

Annealing

Forging

Spinning

Welding, Gas and Electric

Polishing Casting

Soldering and Brazing

Drawing and Punching

Monel Metal Fabrication

Information on the many forms fabricated from Monel Metal, some of which are listed below, may be secured from your Distributor.

Cold drawn wire

Machined articles

Rolled shapes

Rivets, nails, screws,
tacks, etc.

Perforated sheets

Expanded metal

Wire cloth

Chain

Balls

Stamped articles

Tanks

Filter cloth

Tiller rope

Bolts and nuts

Drawn articles

Physical Properties of Monel Metal

Color	White
Melting Point	1350°C (2460°F.)
Density	8.80
Coefficient of thermal expansion per °C:	
(25°C—100°C)	0.000014
(25°C—300°C)	0.000015
(25°C—600°C)	0.000016
Electrical resistivity (at 0°C.).....	$\begin{cases} 256 \text{ ohm} \cdot \text{mil} \cdot \text{foot} \\ 42.5 \text{ microhm} \cdot \text{cm.}^3 \end{cases}$
Temperature coefficient	$\begin{cases} 0.0019 \text{ per } ^\circ\text{C} \\ 0.0011 \text{ per } ^\circ\text{F} \end{cases}$
Heat conductivity	0.06 c.g.s. units (1/15 of that of copper)
Specific heat— (20—400°C). 0.127 cal. per gram per °C	
Magnetic induction at 100 gaussess:	
Rolled metal	1000—1500 gaussess
Magnetic Transformation	80° to 230°F.
Modulus of elasticity	26,000,000
Torsional modulus	9,000,000

WEIGHT CALCULATIONS:

Per cubic inch	0.318 lbs.
Per cubic foot	550 lbs.
Per lineal foot:	
Rounds	(Diam.*) ² x 3.044 lbs.
Squares and Rectangles.....	(Sect. Area*) x 3.876 lbs.
Per square foot (Sheet).....	(Thickness*) x 46 lbs.
*(In inches)	

Mechanical Property Ranges of Standard Monel Metal Products

	Tensile Strength lbs. per sq. in.	Yield Point lbs. per sq. in.	Proportional Elastic Limit lbs. per sq. in.	Elongation in 2 inches per cent	Reduction in Area per cent
Rod and bar					
Cold drawn					
Annealed.....	70,000- 85,000	25,000- 35,000	20,000-30,000	50 - 35	75 - 65
As drawn.....	85,000-125,000	60,000- 95,000	45,000-75,000	35 - 15	65 - 50
Hot Rolled.....	80,000- 95,000	40,000- 65,000	25,000-40,000	45 - 30	65 - 50
Forged.....	80,000-110,000	60,000- 85,000	45,000-65,000	40 - 20	70 - 50
Wire, cold drawn					
Annealed.....	70,000- 85,000	25,000- 35,000	20,000-30,000	45 - 25	
No. 1 temper.....	95,000-110,000	65,000- 85,000		25 - 15	
Regular.....	110,000-140,000			15 - 8	
Spring.....	140,000-175,000			8 - 2	
Plate, hot rolled.....	60,000- 80,000	25,000- 35,000	20,000-30,000	35 - 25	65 - 50
Sheet and strip					
Full-finished sheet.....	65,000- 80,000	25,000- 35,000	20,000-30,000		
Cold rolled					
Annealed.....	65,000- 80,000	25,000- 35,000	20,000-30,000	40 - 25	
Full-hard sheet.....	100,000-120,000	90,000-110,000		8 - 2	
Full-hard strip.....	100,000-125,000	90,000-115,000			
Tubing, cold drawn					
Annealed.....	65,000- 80,000	25,000- 35,000	20,000-30,000		
As Drawn.....	90,000-105,000	60,000- 75,000			
Casting.....	65,000-100,000	30,000- 60,000		35 - 5	35 - 5



Available Literature

While this short summary may give all the facts you need, you will probably desire more definite information or advice on the suitability of Monel Metal for your particular application. Write for a copy of "List B" of available literature, an index to approximately 100 publications that answer practically any question you may have in mind regarding the properties of Monel Metal, service records, or methods of working it. This list, and the publications you request, will be sent to you without any charge or obligation.

Special Grades

Three special grades of Monel Metal have been developed for applications that require a corrosion-resistant material with exceptionally high strength and hardness. Two of these grades are produced in cast forms. They are particularly useful for such applications as valve trim because of their wear-resistance and non-galling qualities. The third grade, furnished in forged shapes and bar stock, is readily hardened by heat treatment after fabrication to 315 Brinell or harder, tensile strength ranging from 120,000 to more than 160,000 psi. Another special, free-machining grade is produced for automatic screw machine work. All four grades possess the same general corrosion-resisting qualities as regular Monel Metal.

Assistance from Sources of Supply

Your nearest source of supply for Monel Metal is listed on the back of this cover. Feel free to call on them for quotations, sales service, or any advice you desire. You will find them well informed on the uses for Monel Metal and glad to be of help to you.

Monel Metal is a registered trade mark applied to a technically controlled nickel-copper alloy of high nickel content. Monel Metal is mined, smelted, refined, rolled and marketed solely by International Nickel.

**Products of "International Nickel" may
be obtained from the following sources:**

**WHITEHEAD METAL PRODUCTS CO. OF
NEW YORK, INC.**

**304-314 Hudson Street, New York, N. Y.
Bronx Office: 1334 Webster Avenue**

Branch Houses:

**235 Bridge Street, Cambridge, Mass.
721-729 Arch Street, Philadelphia, Pa.
254 Court Street, Buffalo, N. Y.
205 Frelinghuysen Avenue, Newark, N. J.**

**WILLIAMS AND COMPANY, INC.
901 Pennsylvania Avenue, Pittsburgh, Pa.**

Branch Houses:

**1748-56 East 22nd Street, Cleveland, Ohio
Henry and Dunlap Streets, Cincinnati, Ohio**

**STEEL SALES CORPORATION
129 South Jefferson Street, Chicago, Ill.**

Branch Houses:

**4150 St. James Street, Detroit, Mich.
4067 Park Avenue, St. Louis, Mo.
647 West Virginia Street, Milwaukee, Wis.
529 South 7th Street, Minneapolis, Minn.**

**J. M. TULL METAL & SUPPLY CO.
285 Marietta Street, Atlanta, Ga.**

**METAL GOODS CORPORATION
1121 Rothwell Street, Houston, Texas**

**EAGLE METALS COMPANY
21 Spokane Street, Seattle, Wash.**

**PACIFIC METALS CO., LTD.
3100 19th Street, San Francisco, Calif.**

Branch House:

1400 South Alameda Street, Los Angeles, Calif.

**PECKOVER'S LIMITED
77 Front Street, E., Toronto, Ontario**

**ROBERT W. BARTRAM, LTD.
277 Duke Street, Montreal, Quebec**

**HENDRIE & BOLTHOFF MFG. & SUPPLY CO.
1621-39 Seventeenth Street, Denver, Colo.**

**WILKINSON COMPANY, LTD.
190 Second Ave. West, Vancouver, B. C.**

Europe:

**HENRY WIGGIN & COMPANY, LTD.
Thames House, Milbank, London, S.W. 1**

**The International Nickel Company, Inc.
67 Wall Street New York, N. Y.**

Sole Producers of Monel Metal